



**Canadian Entity's Preliminary View of Columbia River Treaty  
Post-2024 Called Upon Procedures**

**BC Hydro and Power Authority**

**February 14, 2012**

## 1.0 Introduction

Under the Columbia River Treaty (Treaty), Canada sold to the U.S. for a period of 60 years the right to an assured annual flood control operation associated with 8.45 million acre-feet<sup>1</sup> (MAF) of storage in Canada (Primary Flood Control). This sale of Primary Flood Control expires on 16 September 2024 (which is also the earliest possible unilateral termination date of the Treaty), regardless of whether the Treaty terminates or continues after that date. After 2024, Canadian flood control commitments to the U.S. are limited to an ad hoc “Called Upon”<sup>2</sup> approach, as described in the Treaty and Protocol. The Treaty and Protocol, however, only provide general principles for this ad hoc flood control and do not provide detailed procedures for the implementation of Called Upon.

The purpose of this paper is to present the Canadian Entity’s view of the principles provided by the Called Upon provisions of the Treaty and Protocol. These principles are found in Section 2.0 of this paper. General procedures to implement Called Upon operations that the Canadian Entity believes are consistent with the Treaty and Protocol are described in Section 3.0. These potential procedures are not exhaustive as other Treaty-compliant procedures may be possible. These procedures assume the Treaty continues and that different procedures would be required if the Treaty is terminated.

Under Article VI(4) of the Treaty, Canada is entitled to compensation for Called Upon operations. This paper does not include a discussion or analysis of potential calculation procedures for economic loss or operating costs. However, economic loss could include social and environmental costs, impacts to irrigation, transportation and recreation interests along with impacts to power production in British Columbia and reduced value of generation as a result of drafting and refilling reservoirs for the purposes of Called Upon.

## 2.0 Called Upon Provisions

The key Treaty provisions for the use of Called Upon are described in Article IV(3) of the Treaty, and clarified in Protocol 1 and 1(2). These provisions describe the Canadian obligations and the conditions for the United States (U.S.) to request Called Upon. These provisions establish the principles and some of the terms upon which operational procedures must be based.

- 2.1 Canada may be called upon to operate any Canadian storage in the Columbia River basin to meet flood control needs in the U.S.

Article IV(3): *“... Canada shall, when called upon by an entity designated by the United States of America for that purpose, operate within the limits of existing facilities any storage in the Columbia River basin in Canada as the entity requires to meet*

---

<sup>1</sup> Primary Flood Control Storage was adjusted in 1995 to 8.95 MAF as part of a Canadian option to reallocate flood control storage between the Mica and Arrow reservoirs.

<sup>2</sup> The Treaty does not explicitly use the terms “On-Call” and “Called Upon” for the ad hoc flood control provided under the Treaty for pre-2024 and post-2024, respectively. Instead this has become established terminology used by the Canadian and U.S. Entities.

*flood control needs for the duration of the flood period for which the call is made.”*

This consists of all storage in the Columbia River basin in Canada, including storage at the Treaty dams (Mica, Arrow, and Duncan), and also includes storage in Revelstoke, Kootenay Lake, and the smaller reservoirs such as Whatshan. At Mica, both Treaty and non-Treaty storage would be included. Any call for use of this storage is subject to the conditions following in Sections 2.2 to 2.6 below.

- 2.2 The U.S. must plan to make effective use of their own storage before requesting use of Canadian storage.

Protocol 1: *“... [On-Call / Called Upon] shall be made only to the extent necessary to meet forecast flood control needs in the territory of the United States of America that cannot adequately be met by flood control facilities in the United States of America ...”*

Protocol 1(2): *“The United States entity will call upon Canada to operate [Called Upon storage] only to control potential floods in the United State of America that could not be adequately controlled by all the related storage facilities in the United States of America existing at the expiration of 60 years from the ratification date ...”*

The Entities appear to have accepted *“cannot adequately be met by flood control facilities”* and *“could not be adequately controlled by all the related storage facilities”* to be limited to the facilities that are *effective* (i.e. have an impact) in reducing peak flows at The Dalles on the Columbia River. This concept of *“effective use”* was first used in the Agreed Joint Summary Record, which summarized the agreements reached by United States’ and Canadian negotiators when negotiating the Protocol in 1963-4.

Effective use implies that all U.S. reservoirs that are upstream of The Dalles are to be managed to maximize the reduction of the peak flow at The Dalles throughout the flood event<sup>3</sup>. One way of demonstrating effective use when planning operations is for each U.S. reservoir that could have an impact on flow levels at The Dalles to be maintained at minimum discharge throughout the flood event. If minimum discharge cannot be maintained, effective use can be demonstrated by drafting the reservoir to empty prior to the flood event and discharging as needed to provide maximum downstream flood control during the flood event (as discussed in Section 3.2).

- 2.3 Effective use of all related storage facilities is not limited by licensing and other project purposes such as power, fish, irrigation, or recreation.

Protocol 1: *“... that cannot adequately be met by flood control facilities in the United States of America ...”*

Protocol 1(2): *“... that could not be adequately controlled by all the related storage facilities in the United States of America existing at the expiration of 60 years from the ratification date ...”*

---

<sup>3</sup> The flood event is the period during which flows are forecast to exceed 600,000 cubic feet per second at The Dalles.

Effective use requires the use of storage at any U.S. project which can reduce flows at The Dalles, regardless of its designated use or licensing or the economic cost of using the storage. This includes both Federal and non-Federal projects. In addition to the large headwater projects and Grand Coulee, projects required for effective use would also include (but are not limited to) the Mid-Columbia River projects, the upper Snake River projects (upstream of Brownlee), the lower Snake River projects, and the main stem projects on the lower Columbia River. While projects on the Willamette River are effective for reducing flooding in and around Portland, Oregon and Vancouver Washington, they are not included as the Willamette River joins the Columbia River downstream of The Dalles and as a result are not effective at reducing peak flows at The Dalles.

2.4 Called Upon requests will be made based on forecasts and the potential for floods.

Protocol 1: *“... [On-Call / Called Upon] shall be made only ... to meet forecast flood control needs ...”*

Protocol 1(2): *“The United States of America will call upon Canada to operate [Called Upon storage] only to control potential floods in the [U.S.] ...”*

Protocol 1(3): *“...[On-Call / Called Upon] shall be made only if the Canadian entity has been consulted whether the need for flood control is, or is likely to be, such that it cannot be met by the use of flood control facilities in the [U.S.] ...”*

The provisions in the Protocol are clear that Called Upon requests will be based on forecasts of potential floods and do not require the imminent or actual occurrence of a flood event prior to a U.S. call for Canadian flood control. However the provisions are not specific with regard to the treatment or allocation of forecast risk and uncertainty. The manner of allocating risk of changed or inaccurate forecasts and forecast uncertainty will be an important consideration in the development of detailed procedures to implement Called Upon in order to reduce the likelihood of unnecessary calls and to facilitate timely requests.

Called Upon is expected to be used infrequently and may only be used in very large snow-pack years when it is forecast that the effective use of all storage in the U.S. will be unable to maintain flows at The Dalles below 600,000 cubic feet per second (cfs). Because forecasts are uncertain, the U.S. must make effective use of its storage, even in years when the peak flow may turn out not to exceed 600,000 cfs. Called Upon is not to be used as a mechanism to transfer the responsibility of managing the risk of changing forecasts from U.S. storage to Canadian storage.

2.5 Called Upon may only be used for controlling flows that are forecast to exceed 600,000 cfs at The Dalles, and only to control floods down to 600,000 cfs

Up to 2024, Article IV(2) provides for the operation of the Primary Flood Control storage, as well as any additional storage (On-Call) required for meeting U.S. flood control needs. The pre-2024 On-Call provisions are further clarified in Protocol 1(1): *“Unless otherwise agreed by the Permanent Engineering Board, the need to use [On-Call] shall be considered to have arisen only in the case of potential floods which could result in a peak discharge in excess of 600,000 cubic feet per second at The Dalles, Oregon, assuming the use of all related storage in the United*

*States of America ...*". Thus, On-Call can only be used to reduce flows to 600,000 cfs at The Dalles.

On 16 Sept 2024, the sale of the Primary Flood Control expires, including the Canadian obligation to implement an annual flood control plan. All storage at existing Canadian facilities in the Columbia River basin is then available to be used for ad hoc Called Upon operations. Protocol 1(2) states that *"... in no event shall Canada be required to provide any greater degree of flood control under [Called Upon] than that provided for under [Primary Flood Control + On-Call]"*. Pre-2024, On-Call can be requested to supplement Primary Flood Control in order to reduce flows to 600,000 cfs at The Dalles. Post-2024, Protocol 1(2) provides for a U.S. request for Called Upon using any Columbia River basin storage in Canada to reduce flows to 600,000 cfs at The Dalles. This limit on the degree of flood control was negotiated in the Protocol at the time the Treaty was ratified to ensure that Called Upon was only used when a very large flood is forecasted (estimated in the 1960s as once in 15-20 years) and only after all effective use of U.S. storage.

2.5 Called Upon operation will minimize flood damage in both Canada and the U.S.

The requirement to consider Canadian flood control is a primary obligation, and is to be equally considered with U.S. flood control needs.

Protocol 2: *"... in making calls to operate for flood control pursuant to [Called Upon], every effort will be made to minimize flood damage both in Canada and the United States of America."*

### **3.0 Possible Procedures for Implementing Called Upon under the framework of the Treaty**

Post-2024, Called Upon operation is an ad hoc operation which is expected to be used infrequently. The consultation process for a Called Upon request is described in Protocol 1(3).

Protocol 1(3): *"A call shall be made only if the Canadian entity has been consulted whether the need for flood control is, or is likely to be, such that it cannot be met by the use of flood control facilities in the United States of America ... Within ten days of receipt of a call, the Canadian entity will communicate its acceptance, or its rejection or proposals for modification of the call, together with supporting considerations. ... In the absence of agreement on the call or its terms the United States entity will submit the matter to the Permanent Engineering Board ... If the Permanent Engineering Board does not issue instructions within ten days of receipt of a submission the United States entity may renew the call ... and the Canadian entity shall forthwith honor the request."*

The practicalities of operating such a large, complex system and the potential need to draft large amounts of reservoir storage (whether by generating or potentially spilling) in a timely manner in response to flows that are forecast to exceed 600,000 cfs at The Dalles suggest that the ad hoc consultation process provided by the Treaty and Protocol may not be satisfactory. Without mutually agreeable procedures, the process could be inefficient and have unnecessary adverse impacts. Disagreements between the Entities could cause delays with significant implications. It should be noted that it is unclear whether the Permanent Engineering Board would exist if the Treaty is terminated.

The Canadian Entity believes that the procedural elements described in Sections 3.1 through 3.4 could be followed in a Treaty continue scenario. Different procedures may be possible, based on the Treaty and Protocol provisions described in Section 2.0, for implementing a Called Upon request. Any procedures must be open, transparent and meet the Called Upon principles described in Section 2.0. Accepted procedures would facilitate the consultation process and might allow the Canadian Entity's review of the Called Upon request to proceed in a more timely manner. The options described below assume a Treaty continues scenario because coordinated power operations under the Treaty enable the Canadian power draft to be accurately forecast. If the Treaty is terminated, this will not be the case and these procedures would not apply.

An objective test on the need for Called Upon and the procedures for Canadian and U.S. project operations under a Called Upon request is required. In a given year, if the U.S. Army Corps of Engineers (USACE) forecasts that peak flows at The Dalles will exceed 600,000 cfs, then USACE could request Called Upon and provide:

- (1) the criteria under which Called Upon is requested, including the demonstration of U.S. effective use,
- (2) the timing and an agreed probability level for forecasts that peak flows at The Dalles will exceed 600,000 cfs, and the hydrometeorological data and methodologies on which the forecast is based,
- (3) an operating plan of draft requirements for U.S. and Canadian projects, including draft priorities between U.S. and Canadian projects, during the drawdown period and the principles (and priorities) for dealing with changes in forecast inflows,
- (4) guidelines and procedures for regulating flows to 600,000 cfs, including refill priorities between U.S. and Canadian projects, and conditions defining the end of the regulation period, and
- (5) any additional information related to the assessment and implementation of a Called Upon request.

If a request for Called Upon is accepted, the Canadian Entity, in consultation with the U.S. Entity, would then develop the operating plan for the remainder of the refill period after the likelihood for flows above 600,000 cfs at The Dalles has passed, to return operations to the conditions prescribed by the Treaty Storage Regulation (TSR) study.

The following sections provide more information on procedures that could be acceptable.

### 3.1 Trigger for a Called Upon Request

A Called Upon request requires (i) the effective use of all U.S. storage, and (ii) a forecast that even with effective use of all U.S. storage, peak flows at The Dalles will exceed 600,000 cfs.

The USACE determines the total flood control draft requirement, which is the storage needed to store water volumes in excess of 600,000 cfs at The Dalles. For a given forecast runoff volume, the required storage can be estimated from a relationship between inflow volume above 600,000 cfs and runoff volume, as developed using historical stream flows. A Called Upon request would only be made when the flood control draft requirement is greater than the capability of the U.S. projects to provide effective use storage.

Effective use storage refers to total reservoir storage at all projects that can be used to store inflows and thus reduce flows at The Dalles. At each project, this storage is determined as the lesser of (i) the entire storage and (ii) the storage that would be refilled during the flood event while releasing minimum discharge.

In determining the need for Called Upon, the U.S. would provide Canada with the necessary information required to assess the request, including the forecast runoff volumes, planned operation of U.S. reservoirs for effective use, the total amount of storage at each Canadian reservoir proposed to meet the flood control draft requirement, and a proposed plan for operating the Canadian Called Upon storage.

### 3.2 Drafting U.S. Storage

For the drawdown period, new post-2024 Storage Reservation Diagrams (new SRDs<sup>4</sup>) for U.S. reservoirs must be developed to demonstrate and implement drafting to target minimum draft levels that will enable the effective use of all U.S. reservoirs for reducing flows at The Dalles during the flood event. These new SRDs for U.S. reservoirs are required as the existing SRDs are not necessarily designed to meet the Called Upon criteria and may not use all U.S. effective use storage. As Called Upon is expected to be used infrequently, only in very large snow-pack years, the USACE must ensure that management of forecast risk and uncertainty is provided by U.S. storage by the use of new SRDs.

Effective use target (end-of-April) draft levels in the new SRDs could be developed using historical flows and calculated as the volume of inflows less minimum outflows during the flood event for each water year. If the required draft volume exceeds the total reservoir storage, then the target draft level would be to empty the reservoir. Allowance for forecast risk and uncertainty should be incorporated in the development of the new SRDs. These new SRDs may also be adjusted for local flood control needs.

At projects with upstream U.S. storage regulation, the target draft level depends on the regulation of the upstream project(s). Any variation in the upstream project operation affects the inflows to the downstream project, and therefore, its target draft level. If minimum discharge can be achieved over the forecast peak flow period without drafting the reservoir to empty, then the upstream project regulation may be varied to the extent that minimum discharge can still be achieved in the downstream reservoir(s). If the downstream reservoir cannot achieve minimum discharge when drafted completely, then the upstream project(s) will be required to draft as far as necessary to enable the downstream project to reduce discharge (to minimum, if possible) during the flood event.

### 3.3 Drafting Canadian Called Upon Storage

At Canadian projects, the requested Called Upon volume would be limited to the storage required to reduce the forecast peak flow to 600,000 cfs at The Dalles, assuming the effective use of all U.S. projects. In general, storage from Mica, Arrow and Duncan is expected to be sufficient to reduce peak flows at The Dalles to 600,000 cfs. However, if additional storage was still required to reduce forecast flows to 600,000 cfs, then drafts from other Canadian reservoirs would also be used.

---

<sup>4</sup> These new SRDs for U.S. reservoirs are expected to be lower than the existing SRDs and would be applicable post-2024.

A Called Upon request will only be agreed to if the U.S. projects are drafting according to or below their new SRDs. Once the Called Upon request is agreed to, Canadian projects will target the agreed Called Upon drafts. If changes in the forecast runoff volume result in changes to the amount of Called Upon draft required, then the target draft levels will be adjusted accordingly. Unless otherwise agreed to during discussions of proposed changes, any change in U.S. reservoir operations from the new SRDs would indicate that effective use is no longer being implemented and hence, Canada would have no further obligation to provide Called Upon operations.

Once drafted, reservoir levels in the U.S. and Canada will be maintained until the start of the flood event or adjusted as forecasts change.

### 3.4 Refill Period

During the flood event, the USACE can direct, after consultation with the Canadian Entity, the re-filling operation of the Canadian Called Upon storage to manage the peak flows at The Dalles to a target flow of not less than 600,000 cfs. U.S. reservoirs must be managed to maximize flow reduction at The Dalles during this period. USACE may need to increase discharge from projects to manage changing conditions (such as revised forecasts) and to prevent the reservoirs from filling too early.

Once the flood event has passed (or if the flood event does not materialize), and the unregulated flows at The Dalles are forecast to remain below 600,000 cfs with the effective use of all U.S. storage, then Canadian project operations reverts back to Canada, for refill based on Canadian needs and priorities.

### 3.5 Incorporating Uncertainty and Risk in Called Upon Procedures and Allocating Risk

Uncertainty can be incorporated in different areas such as in the development of the U.S. flood draft requirement, the new SRDs for U.S. reservoirs and in the forecast runoff volumes. Accepting too much risk can result in late requests and the inability to draft the required storage at U.S. or Canadian projects. Being overly conservative can lead to more false alarms, greater Canadian draft requirements, and a lower probability of refill of Canadian storage. Assumptions regarding uncertainty in the procedures need to be explicitly stated, and it needs to be clear which Entity is accepting which risks. Called Upon is not a mechanism to transfer the responsibility of managing risk to the Canadian Entity.

## 4.0 Effective Use at U.S. Reservoirs

Effective use requires that all available U.S. storage that can contribute to reducing flows at The Dalles be used to store water during peak flow times. The Entities joint Phase 1 technical studies examined effective use at large reservoirs (Libby, Hungry Horse, Dworshak, Brownlee, Grand Coulee) only.

The Canadian Entity has conducted a preliminary analysis to determine the ability of smaller U.S. reservoirs on the Columbia main stem and tributaries to reduce flows at The Dalles. The analysis also estimates U.S. energy losses due to effective use at these facilities. The analytical approach used assumptions about how the reservoirs would draft before the flood event, fill from minimum to full pool, and then draft back to their target elevations. The purpose of the analysis was to determine order of magnitude estimates and identify trends only. Changes to the methodology could be made to produce more accurate results. The analysis examined 1948 and four potential Called Upon years (1956, 1972, 1976, 1997) from the U.S. Entity's Iteration #1 studies. Reservoirs examined included Chief



Joseph, Wells, the five mid-Columbia facilities belonging to public utilities, McNary, John Day, The Dalles, and Lower and Upper Snake River dams.

The results<sup>5</sup> indicate that effective use of U.S. reservoirs could reduce flow at The Dalles to 600,000 cfs in all but one year when assuming no power draft of Canadian storage. If a power draft of Canadian storage is assumed, then Called Upon was not required in the historical record. The total energy loss at the small U.S. facilities per Called Upon year ranged from 1300 – 3000 gigawatt hours with an estimated value of \$40 to \$150 million<sup>6</sup>.

## **5.0 Winter Flood Events**

Unlike spring flood events which are mainly snowmelt driven and can be planned months in advance based on inflow forecasts, winter flood events tend to be due to intense rain events which are less predictable and more immediate. This gives rise to the following issues:

1. With the much shorter time-frame, the ability to draft the large amounts of storage (in the U.S. and Canada) needed to manage large flood events in excess of 600,000 cfs at The Dalles is significantly restricted. While some larger reservoirs may already be drafted for power or other purposes, others may not have sufficient time to draft deep enough to meet the effective use requirements under a Called Upon operation.
2. The Dalles is the control point in the Treaty for system flood control, which is appropriate for spring floods that originate primarily from snowmelt in the upper Columbia River basin. However, rain driven winter flood events will likely have significant contributions from basins downstream of The Dalles (e.g. from the Willamette River). The control point of The Dalles is not suitable for protecting Portland, OR or Vancouver, WA from winter rainfall flood events that may occur on the Willamette (e.g. the winter event of 1996).
3. Protocol 1(3) stipulates that Canada must respond to the call within ten days, and if there is no agreement on the request, then the U.S. may submit the matter to the Permanent Engineering Board who may then take up to ten days to issue instructions. In total, up to twenty days may be used by the Canadian Entity and the Permanent Engineering Board to deliberate on the call request. This consultation protocol clearly would not work for winter flood events and indicates that Called Upon was not meant to be used for winter floods.

For these reasons, the Canadian Entity believes that Called Upon was not developed for winter storms, and could never be effectively applied to help mitigate them.

---

<sup>5</sup> The analysis referred to in this paragraph used Canadian operation from the B1 and B2 scenarios in the joint Phase 1 Technical studies completed by the Entities.

<sup>6</sup> Based on an assumed energy value of \$30-\$50/MWh.

## **Treaty Provisions for Called Upon Operations (Except Payment)**

### **Article IV(2)**

For the purposes of flood control until the expiration of sixty years from the ratification date, Canada shall

- (a) operate in accordance with Annex A and pursuant to flood control operating plans made thereunder
  - (i) 80,000 acre-feet of the Canadian storage described in Article II(2)(a),
  - (ii) 7,100,000 acre-feet of the Canadian storage described in Article II(2)(b),
  - (iii) 1,270,000 acre-feet of the Canadian storage described in Article II(2)(c),

provided that the Canadian entity may exchange flood control storage under subparagraph (ii) for flood control storage additional to that under subparagraph (i), at the location described in Article II(2)(a), if the entities agree that the exchange would provide the same effectiveness for control of floods on the Columbia River at The Dalles, Oregon;

- (b) operate any additional storage in the Columbia River basin in Canada, when called upon by an entity designated by the United States of America for that purpose, within the limits of existing facilities and as the entity requires to meet flood control needs for the duration of the flood period for which the call is made.

### **Article IV(3)**

For the purposes of flood control after the expiration of sixty years from the ratification date, and for so long as the flows in the Columbia River in Canada continue to contribute to potential flood hazard in the United States of America, Canada shall, when called upon by an entity designated by the United States of America for that purpose, operate within the limits of existing facilities any storage in the Columbia River basin in Canada as the entity requires to meet flood control needs for the duration of the flood period for which the call is made.

### **Protocol 1**

If the United States entity should call upon Canada to operate storage in the Columbia River Basin to meet flood control needs of the United States of America pursuant to Article IV(2)(b) or Article IV(3) of the Treaty, such call shall be made only to the extent necessary to meet forecast flood control needs in the territory of the United States of America that cannot adequately be met by flood control facilities in the United States of America in accordance with the following conditions:

- (1) Unless otherwise agreed by the Permanent Engineering Board, the need to use Canadian flood control facilities under Article IV(2)(b) of the Treaty shall be considered to have arisen only in the case of potential floods which could result in a peak discharge in excess of 600,000 cubic feet per second at The Dalles, Oregon, assuming the use of all related storage in the United States of America existing and under construction in January 1961, storage provided by any dam constructed pursuant to Article XII of the Treaty and the Canadian storage described in Article IV(2)(a) of the Treaty.

- (2) The United States entity will call upon Canada to operate storage under Article IV(3) of the Treaty only to control potential floods in the United States of America that could not be adequately controlled by all the related storage facilities in the United States of America existing at the expiration of 60 years from the ratification date but in no event shall Canada be required to provide any greater degree of flood control under Article IV(3) of the Treaty than that provided for under Article IV(2) of the Treaty.
- (3) A call shall be made only if the Canadian entity has been consulted whether the need for flood control is, or is likely to be, such that it cannot be met by the use of flood control facilities in the United States of America in accordance with subparagraphs (1) or (2) of this paragraph. Within ten days of receipt of a call, the Canadian entity will communicate its acceptance, or its rejection or proposals for modification of the call, together with supporting considerations. When the communication indicates rejection or modification of the call the United States entity will review the situation in the light of the communication and subsequent developments and will then withdraw or modify the call if practicable. In the absence of agreement on the call or its terms the United States entity will submit the matter to the Permanent Engineering Board provided for under Article XV of the Treaty for assistance as contemplated in Article XV(2)(c) of the Treaty. The entities will be guided by any instructions issued by the Permanent Engineering Board. If the Permanent Engineering Board does not issue instructions within ten days of receipt of a submission the United States entity may renew the call for any part or all of the storage covered in the original call and the Canadian entity shall forthwith honor the request.

## **Protocol 2**

In preparing the flood control operating plans in accordance with paragraph 5 of Annex A of the Treaty, and in making calls to operate for flood control pursuant to Articles IV(2)(b) and IV(3) of the Treaty, every effort will be made to minimize flood damage both in Canada and the United States of America.